

Training in Cardiopulmonary Resuscitation

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CARDIAC ARREST, or as it is more correctly called, cardiopulmonary arrest, resulting from ventricular standstill or fibrillation is an unpredictable complication in 8,000 to 10,000 surgical procedures performed in this country each year (1-3). Cardiopulmonary arrest is also the presumed cause of death in many of the 500,000 persons per year who die suddenly from coronary artery disease (3-5). Proper application of current concepts of cardiopulmonary resuscitation may save many of those affected while in operating room areas (6, 7), and an estimated one-half to two-thirds of sudden coronary deaths may be ultimately avoided through prompt institution of therapy (4-6, 8).

Cardiopulmonary arrest can result from a wide variety of circumstances including anoxia, drug toxicity or idiosyncrasy, and coronary occlusion. It is often a relatively transient phenomenon (9), occurring in hearts with an essentially intact myocardium (10); thus it has been stated that the heart needs only a second chance to survive (11).

Cardiopulmonary arrest has been managed in the past by open-chest cardiac massage and direct application of electrical currents to the myocardium (6, 12, 13). Because of the special qualities of training and initiative required, however, to perform emergency thoracotomy and direct cardiac massage and the possibility of serious sequelae to such a vigorous procedure, efforts have been directed toward developing simpler techniques of stimulating and defibrillating human hearts, such as application of

electric shocks to the chest externally. This work led to the successful reports by Zoll and associates (14) in 1956 and of Kouwenhoven and associates in 1957 (15). More widespread clinical application of pacemakers and alternating current external defibrillators resulted.

It was further recognized that successful application of these electrical techniques depends upon the avoidance of myocardial and cerebral anoxia. After circulation has ceased for 3 to 4 minutes, the possibility of successful resuscitation is markedly decreased unless adequate circulatory and ventilatory support is maintained (16). A great stride in the development of effective emergency ventilatory therapy was taken in 1958 when expired air respiration was demonstrated to be superior to previously accepted manual methods (17-19). An initial attempt to combine this technique with internal cardiac massage occurred through the efforts of Dr. Claude S. Beck, professor at Western Reserve University School of Medicine, Cleveland, and the work of the National Resuscitation Society, which with the American College of Cardiology conducted several 2-day courses in 1958 in the treatment of acute respirocardiac failure (13, 20, 21). Concomitant experimental studies exploring the physiology and technique of closed-chest cardiac massage showed that satisfactory cardiac output during cardiac arrest could be maintained by this method (12, 22). It soon became clear that expired air respiration and closed-chest cardiac massage when performed properly in combination provide effective emergency ventilatory and circulatory support in cases of cardiac arrest and a suitable physiological environment for the successful application of external electric currents where such application is indicated (3, 6, 9, 12, 23, 24).

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Initial clinical studies demonstrated that as many as 70 percent of patients with cardiac arrest could be temporarily returned to their pre-arrest status and that an appreciable number of patients were completely revived (3, 6, 12, 23-26). In addition, the relative simplicity of these cardiopulmonary resuscitation techniques also seemed to justify their wide application. The salvage rate of cardiac patients in hospitals apparently could be improved by better in-service training of all physicians and nurses (27). It was further recognized that cardiopulmonary resuscitation could be instituted in out-of-hospital cardiopulmonary emergencies, and its application by properly trained dentists and rescue personnel was also endorsed (28). A working scheme to teach various aspects of cardiopulmonary resuscitation to appropriate portions of the population was devised (4, 27). Promulgation of effective training methods for medical and rescue personnel seemed to be the next essential step.

Initial Experience and Results

As a result of the strenuous efforts of the American Heart Association, acting through its State and local affiliates, approximately 47,000 persons, including 10,000 physicians, were trained in its programs in 1961-62, according to Dr. Frederick J. Lewy, the association's director of professional education (personal communication). Since January 1963 the Michigan Heart Association alone has trained 16,000 persons in resuscitation techniques (29). In addition, several leaders in the field, such as Dr. James R. Jude and Dr. William B. Kouwenhoven, department of surgery, Johns Hopkins Hospital, Baltimore, have given courses by special invitation, and numerous scattered medical societies have conducted programs, as have many individual physicians.

The residual effect of these training programs is difficult to estimate since the number and results of the statewide or local programs being conducted are not uniformly organized or reported. In States such as California, Louisiana, Maryland, Michigan, New York, and South Carolina, nuclei for the continued statewide training and expansion of this technique were formed. In other States no regular statewide

training program is known to have been offered, while in some areas only selected physicians were sent to special training centers. The contents of the training programs varied from a demonstration film to a full day's session including practice on a manikin, a suitably prepared animal demonstration, and a testing procedure. Numerous State, county, and local resuscitation programs have been conducted, but their approach, coverage, and value have not been uniform. Thus, many otherwise well-trained physicians have received little authoritative knowledge about current concepts of cardiopulmonary resuscitation.

Information on the actual clinical effectiveness of external cardiac compression in cardiopulmonary arrest is gradually becoming more available. In a recent report by Jude (7), approximately 16 percent of 185 patients on whom resuscitation was attempted outside operating room areas survived; in a series of 77 patients treated within the operating room area, 51 percent survived; finally, in a summary of 969 reported cases where external cardiac massage was used in all areas of the hospital, an overall survival rate of 25 percent was achieved.

The good results in surgical patients are no doubt related to their better cardiac status, the usually transient etiology of their cardiopulmonary arrest, and the ready availability of equipment and personnel. Presumably, as programs for effective treatment of cardiac arrest become more clearly defined, as exemplified by those of Lefemine (2), Zoll (30), Johnson (31), and Phillips (32), and as specific units for the care of acute coronary patients develop (6, 33, 34), results outside the operating room will improve accordingly.

Despite earlier reports of the physiological effectiveness of closed-chest cardiac compression in producing adequate circulation (22, 35-37), a recent report (38) on three patients indicated little blood flow and cardiac output; these moribund patients, however, either had significant valvular disease or were seriously ill from other causes. The frequent occurrence of rib fractures during external cardiac compression has been noted (23, 39-41). (Jude, in a personal communication, reported that these injuries more commonly represent costochondral separation.) The frequent occurrence of bone mar-

row emboli (42) during this procedure has also been noted. The clinical significance of these findings is, however, debatable according to Jude, as well as others (40, 43). Rupture of the liver (39, 41, 44) and spleen are rarely reported complications. Clark (41) and Jude consider these latter complications extremely unlikely when the resuscitation techniques are properly performed.

Certainly, detailed communitywide studies (for example, cardiac arrest registries) to determine the causes and evaluate the therapy of cardiac arrest both in and out of hospital are needed. At present, comprehensive registries are known to be under development only in New York and California. Black and Black have illustrated the effectiveness of a coordinated effort of well-trained physicians and well-organized hospital units in performing successful cardiopulmonary resuscitation in cardiac arrest occurring outside a hospital (45).

Status of Training Programs

The lack of uniformity in the teaching of cardiopulmonary techniques and in their application may be traced, at least partially, to frequent disagreement and uncertainty as to who, other than physicians, should be trained in them. There is often great disagreement as to whether dentists, nurses, rescue workers, and lay personnel should perform closed-chest cardiac resuscitation. For example, the role of the nurse must be interpreted in the light of laws concerning the practice of nursing (nurse practice acts), which vary considerably from State to State. No nursing practice act includes either the elements of diagnosis or the prescription of treatment in its definition of treatment; the ultimate interpretation of medical and nursing practice acts is a function of the courts (46). To aid in such decisions, policy statements must be formulated and issued by professional groups or by a State attorney general (47). It is clear that the ability to perform particular physical techniques upon the order of a physician does not encompass the qualifications to decide about initiating such acts.

The guidance provided by policy statements should help to clarify the circumstances under

which a nurse might be expected to participate in a procedure under question and the extent of her participation. To encourage the development of professional opinion, the American Nurses' Association has advised that State nurses associations initiate the development of policy statements for procedures such as closed-chest cardiac resuscitation (48). State medical societies and other appropriate groups, such as hospital associations, have been invited to join with the State nurses' association in a study of the problems occurring within this dependent function of nursing and to determine criteria that will safeguard proper practice and sound procedure. The decision to implement such a statement, as well as the responsibility for organizing educational programs and the other necessary corollaries of the joint statement, of course rests with the individual institution or organization. Such a statement was prepared by the California Nurses' Association in 1962; it permits nurses to apply cardiopulmonary resuscitation in instances of cardiac arrest when no physician is present. Experience has shown that nurses, given the necessary training and mandate, can perform these techniques effectively (7).

The New York State Department of Health has endorsed the training in resuscitation techniques not only of nurses but also of dentists, hospital personnel, and other interested nonprofessional personnel (49). In memorandum CS64-511 (May 1964) addressed to all heart associations, the central committee of the American Heart Association board of directors, acting on the recommendation of its committee on resuscitation, pronounced cardiopulmonary resuscitation an "emergency" measure to be applied "by properly trained individuals of the nursing, allied health professions and rescue squads." Thus, application of the technique and the nurse's role in it are gradually being clarified.

The adoption of cardiopulmonary resuscitation by certain high-risk lay personnel, such as electrical workers, has gained support (50). Its general application by rescue workers has often failed, however, through lack of training success, initiative, and organization. (This information on rescue workers was provided by Dr. Peter Safar, professor and chairman of the



Figure 1. Initial steps in diagnosis of cardio-pulmonary arrest: determination of pupillary size and presence of carotid pulse (Resusci-Anne manikin)

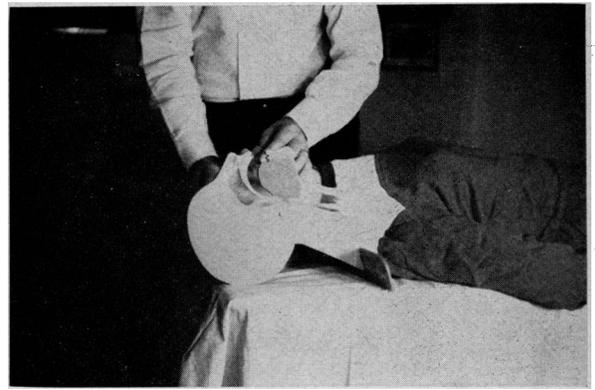


Figure 2. Sufficient extension of head is required to assure an unobstructed airway (manikin and cross-section airway model)



Figure 3. Mouth-to-mouth ventilation. Gauge to measure adequacy of performance is placed beside manikin's head

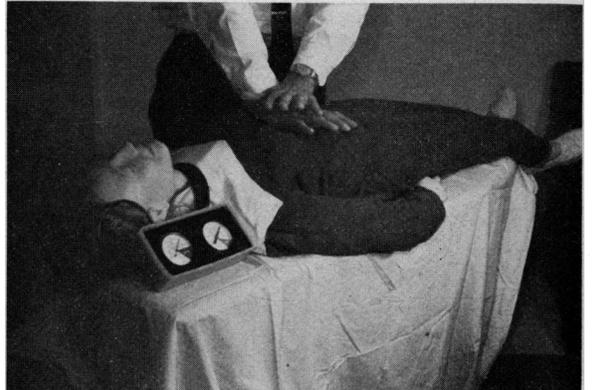


Figure 4. Position for external cardiac massage. Gauge to measure adequacy of compression is placed beside manikin's head

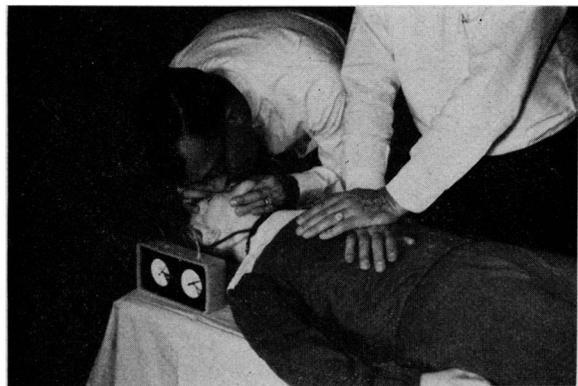


Figure 5. Closed-chest cardiac compression and mouth-to-mouth ventilation being performed by two persons using manikin. Gauges to measure the adequacy of ventilation and compression are placed beside manikin's head

department of anesthesiology, University of Pittsburgh School of Medicine, Dr. Charles Weingarten, heart disease control officer of Brookline, Mass., and Dr. Peter Braun, heart disease control officer of Trenton, N.J., in personal communications.) Nevertheless, Dr. J. G. Fred Hiss, director of the bureau of heart disease, New York State Department of Health, reported (personal communication) that more than 1,200 pole-team workers of the Long Island Lighting Co. and 16,000 workers at Consolidated Edison, New York City, have been trained. In 41 cases of cardiac arrest where resuscitation was performed by rescue squads, Weingarten and Braun stated that no secondary injury resulted and five persons survived.

Evaluation of training methods for medical, paramedical, and nonselected lay personnel are presently under investigation at the University of Pittsburgh under Safar, with support of the Heart Disease Control Branch, Public Health Service. As a result of the University of Pittsburgh project alone, nearly 1,000 persons have been thoroughly trained. In New Jersey and Massachusetts, field officers of the Heart Disease Control Branch have conducted instruction programs for several hundred rescue squad workers. Materials evaluated in these projects include various audiovisual aids, training manuals, and testing procedures.

To provide more well-trained instructors of cardiopulmonary resuscitation, the Heart Disease Control Branch has sponsored courses for instructors at Johns Hopkins Hospital, directed by Jude, which various field staff officers and selected private physicians attended. These sessions have comprised lectures and demonstrations by instructors, practice by trainees on manikins and animals, and excellent use of audiovisual aids. Similar future courses are planned at this hospital, at Northwestern University Medical School under the direction of Dr. Oglesby Paul, and at the Kansas City General Hospital under the direction of Dr. James O. Elam. The heart program also sponsored courses under the direction of Jude at meetings of the Chicago Dental Society in February 1964 and of the American Dental Association in November 1964.

Experience with these projects indicates that an effective course must include a standard, authoritative film presentation, an illustrated slide lecture covering the physiology, anatomy, and application of resuscitation techniques, and supervised practice on a manikin, followed by a test.

Future Activities

Programs for future training in cardiopulmonary resuscitation were placed on a firmer base after the meeting of the Second National Conference on Cardiovascular Diseases in November 1964. At the conference, two committees thoroughly considered current methods, teaching, and organization of resuscitation training with a view toward establishing accept-

able principles of practice and guidelines for broad educational programs.

Advanced courses for physicians in techniques of defibrillation and of combating acidosis, infection, shock, and other complications of the post-revival period are now being conducted at various regional centers throughout New York State under the auspices of the State Department of Health, according to Hiss (personal communication). These are intended to supplement the 210 courses in cardiopulmonary resuscitation for physicians already conducted in that State.

Finally, methods of applying existing Public Health Service short-term training grant funds to develop more elaborate courses in resuscitation and treatment of arrhythmias in medical schools and health departments are being explored.

Summary and Conclusions

An effective cardiorespiratory resuscitation technique is presently available. Proper application of this technique requires continuing evaluation and standardization of training methods; adequate instruction by qualified physicians; clarification of the role of nurses, rescue workers, and lay personnel; and the reorganization of existing supportive community emergency facilities supplying ambulance and hospital care.

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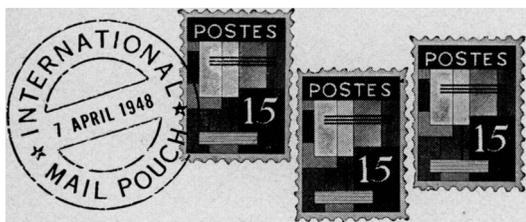
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Progress in Mosquito Eradication

The Pan American Sanitary Bureau reports that steady progress has been made in the curbing of yellow fever through eradication of the *Aedes aegypti* mosquito. As a result of a continent-wide campaign begun in 1947, 16 countries have been declared free of the mosquito. They are Bolivia, Brazil, Costa Rica, Chile, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, British Honduras, and the Panama Canal Zone.

Argentina and Bermuda are also considered free of the disease. However, verification by the health officials of Argentina and Bermuda is still needed in order for them to be certified as free from *Aedes aegypti* by the Pan American Sanitary Bureau.

Other areas making considerable gains in mosquito eradication are Colombia, which may be declared free in 1965, and Cuba. On this island, 658 of the 726 localities which were infested in 1954 have been cleaned out.

The United States is beginning its campaign in 1964 through the *Aedes aegypti* eradication department of the Communicable Disease Center in Atlanta, Ga. The Public Health Service has been given by Congress a \$3 million budget to begin an eradication

program aimed first at Florida, Texas, Puerto Rico, and the Virgin Islands. Later, it will be extended to Alabama, Arkansas, South Carolina, Georgia, Louisiana, Mississippi, and Tennessee. The Service expects that the complete elimination of the mosquito will require a 5-year campaign, costing \$45 million.

In addition to the southern United States, the areas of the Western Hemisphere in which *Aedes aegypti* infestation remains a serious problem are the Dominican Republic, Haiti, Jamaica, a part of Venezuela, and the British, Dutch, and French Guianas.

Medical Survey in Remote Areas

A team to survey the prevalence of disease in five remote areas of the world has been organized by the Johns Hopkins University School of Hygiene and Public Health for a 3-year, \$700,000 project. The areas are Latin America, the Mid East, Central Asia, Africa, and the Pacific Islands. Peru has been selected as the first country for study.

Professional team members include two physicians, a nurse, a cultural anthropologist, a laboratory director, two technicians, and a sanitary engineer or a geologist-geographer. They will use statistical methods and tools to determine the prevalence of selected diseases and conditions.

Each person in carefully selected households in representative villages or geographic areas will be given a thorough examination plus laboratory studies and a chest X-ray. Physiological measurements such as cholesterol levels, skin-fold thickness, and blood pressures will also be taken to provide comparisons with the U.S. population.